The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

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1. A charged particle detection system, comprising:

(a) an electronic multiplexing unit in proximity to

(b) a plurality of charge-collecting zones,

wherein each charge-collecting zone comprises a conductive material for receiving and storing charge,

wherein each charge-collecting zone is isolated and electrostatically shielded from neighboring charge-collecting zones by a separator comprising an insulated electrical conductor held at a reference potential,

wherein each charge-collecting zone is electronically interfaced to the multiplexing unit, and

wherein the multiplexing unit is interfaced to a means for measuring the charge collected by the charge-collecting zones.

2. The system of Claim 1, wherein the multiplexing unit effects switching through sequencing using a Gray-code.

3. The system of Claim 1 having a duty cycle for charge collecting in charge-collecting zones greater than 98% for each readout cycle.

4. The system of Claim 1, wherein the separator is comprised of insulating and conducting layers.

5. The system of Claim 4, wherein the insulating layer comprises a high dielectric strength, low-leakage material.

6. The system of Claim 4, wherein the conducting layer comprises aluminum.

7. The system of Claim 4, wherein the insulating layer comprises aluminum oxide.

8. The system of Claim 1, wherein the separator supports the charge collecting zones.

9. The system of Claim 1, wherein the conductive material comprises a metal selected from the group consisting of copper, chromium, gold, and mixtures thereof.

10. The system of Claim 1, wherein the conductive material comprises vapor deposited chromium and gold.

11. The system of Claim 1, wherein at least one charge-collecting zone comprises a Faraday cup.

12. The system of Claim 11, wherein each Faraday cup has an aspect ratio greater than about 2:1.

13. The system of Claim 1, wherein the plurality of charge-collecting zones is a Faraday cup detector array.

14. The system of Claim 1, wherein the plurality of charge-collecting zones is a linear array of Faraday cups.

15. The system of Claim 1, wherein the plurality of charge-collecting zones is a two-dimensional array of Faraday cups.

16. The system of Claim 1, wherein the plurality of charge-collecting zones comprises a stack of Faraday cups.

17. The system of Claim 1, wherein the system measures absolute ion current.

18. The system of Claim 1, wherein the system measures ion currents from about 0.2 pA to about 1.4 μA.

19. The system of Claim 1, wherein the plurality of charge-collecting zones comprises 2^n zones, wherein n is an integer greater than zero.

20. The system of Claim 1, wherein the plurality of charge-collecting zones comprises 256 zones.

21. The system of Claim 1, wherein the a means for measuring the charge collected by charge-collecting zones is selected from an operational-amplifier and an operational-amplifier-integrator.

22. The system of Claim 1, further comprising a mask having a first surface facing the charge-collecting zones and a second surface facing outward from the charge-collecting zones, wherein the first surface is nonconductively attached to the charge-collecting zones, and wherein the second surface comprises an electrically conductive surface.

23. The system of Claim 22, wherein the mask carries a suppressor grid held at a predetermined potential.

24. The system of Claim 1, further comprising a heating means for increasing the temperature of the charge-collecting zones.

25. The system of Claim 1, further comprising a temperature control means for controlling the temperature of the system.

26. The system of Claim 1, wherein the separator, the plurality of charge-collecting zones, the electronic multiplexing unit, and the means for measuring the charge collected by charge-collecting zones are mounted on a single substrate.

27. The system of Claim 26, wherein the substrate comprises a printed circuit board having traces.

28. The system of Claim 27, wherein the traces are electrically connected to the charge-collecting zones directly.

29. The system of Claim 1, wherein the plurality of charge-collecting zones is microfabricated.

30. The system of Claim 29, wherein the plurality of charge-collecting zones comprises a Faraday cup detector array.

31. The system of Claim 29, wherein the plurality of charge-collecting zones comprises an array of Faraday cups, each cup having a unit cell size of about 100 µm.

32. The system of Claim 29 microfabricated by a deep reactive ion etching process.

33. The system of Claim 29 microfabricated by a lithographie-galvanoformung-abformung process.

34. A method for measuring charged particle beam intensity, comprising impinging a charged particle beam onto a charged particle beam detector system, wherein the charged particle beam detection system comprises;

(a) an electronic multiplexing unit in proximity to

(b) a plurality of charge-collecting zones,

wherein each charge-collecting zone comprises a conductive material for receiving and storing charge,

wherein each charge-collecting zone is isolated and electrostatically shielded from neighboring charge-collecting zones by a separator comprising an insulated electrical conductor held at a reference potential,

wherein each charge-collecting zone is electronically interfaced to the multiplexing unit, and

wherein the multiplexing unit is interfaced to a means for measuring the charge collected by the charge-collecting zones.

35. The method of Claim 34, wherein the detection system further comprises a mask having a first surface facing the charge-collecting zones and a second surface facing outward from the charge-collecting zones, wherein the first surface is nonconductively attached to the charge-collecting zones, and wherein the second surface comprises an electrically conductive surface.

36. The system of Claim 35, wherein the mask carries a suppressor grid held at a predetermined potential.

37. The method of Claim 36, wherein the predetermined potential reduces loss of charged particles originating from sputtering after collection of a highly energetic charged particle.

38. The method of Claim 34, wherein at least one charge-collecting zone comprises a Faraday cup.

39. The method of Claim 34, wherein the plurality of charge-collecting zones comprises a Faraday cup detector array.

40. A charged particle analyzer or charged particle separator, comprising:

(a) a source of charged particles;

(b) means for forming a beam of charged particles; and

(c) means for directing the beam onto a charged particle beam detection system, wherein the charged particle beam detection system comprises:

(i) an electronic multiplexing unit in proximity to

(ii) a plurality of charge-collecting zones,

wherein each charge-collecting zone comprises a conductive material for receiving and storing charge,

wherein each charge-collecting zone is isolated and electrostatically shielded from neighboring charge-collecting zones by a separator comprising an insulated electrical conductor held at a reference potential,

wherein each charge-collecting zone is electronically interfaced to the multiplexing unit, and

wherein the multiplexing unit is interfaced to a means for measuring the charge collected by the charge-collecting zones.

41. The analyzer of Claim 40, wherein the detection system further comprises a mask having a first surface facing the charge-collecting zones and a second surface facing outward from the charge-collecting zones, wherein the first surface is nonconductively attached to the charge-collecting zones, and wherein the second surface comprises an electrically conductive surface.

42. The analyzer of Claim 41, wherein the mask carries a suppressor grid held at a predetermined potential.

43. The analyzer of Claim 40, wherein each charge-collecting zone comprises a Faraday cup.

44. The analyzer of Claim 40, wherein the plurality of charge-collecting zones comprises a Faraday cup detector array.

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45. A charged particle analyzer comprising the ion beam detection system according to any one of Claims 1 to 39.

46. The charged particle detection system of Claim 13 wherein the FCDA is constructed from a compressed sandwich of precision-cut laminates and shims defining the Faraday cups and electrostatic separators.

47. The charged particle detection system of Claim 13 wherein the FCDA is constructed from a block of oxidizable metal bonded onto an insulating substrate with a metal oxide forming the insulation layer and high aspect ratio machined channels forming the Faraday cups.

48. The charged particle detection system of Claim 47 wherein the FCDA is constructed from a hard anodized metal selected from the group consisting of aluminum, copper, nickel, and titanium.

49. The charged particle detection system of Claim 47 wherein the FCDA is constructed using electric discharge machining (EDM) of a hard anodized metal selected from the group consisting of aluminum, copper, nickel, and titanium.

50. The charged particle detection system of Claim 13 wherein the FCDA is constructed as an additive deposition or template electroplating of high aspect ratio metal regions to form the Faraday cups and their electrostatic separators.

51. The charged particle detection system of Claim 50 wherein the high aspect ratio metal parts are created by Lithography-Galvanoformung-Abformung (LIGA).

52. The charged particle detection system of Claim 50 wherein the high aspect ratio metal parts are created by deep ultraviolet photolithography of thick photoresist.

53. The charged particle detection system of Claim 13 wherein the FCDA is constructed by subtractive etching of a single crystal semiconductor wafer or chip with a high aspect ratio to form the Faraday cups.

54. The charged particle detection system of Claim 53 wherein silicon comprises the conducting layer.

55. The charged particle detection system of Claim 53 wherein silicon dioxide comprises the insulating layer.

56. The charged particle detection system of Claim 53 wherein gallium arsenide comprises the conducting layer.

57. The charged particle detection system of Claim 53 wherein deep reactive ion etching (DRIE) is used to etch the Faraday cups.

58. The charged particle detection system of Claim 53 wherein the FCDA is formed on the same wafer or chip as other active electronic circuitry.

59. A Faraday cup detector array, comprising:

(a) a plurality of Faraday cups;

(b) a partially insulated conductive housing in which the plurality of cups is supported, the conductive housing being electrically connected to a reference potential; and

(c) means for electrically connecting the plurality of cups to an electronic interface,

wherein each Faraday cup has a unit cell comprising two conductive material-clad insulating walls separated by a U-shaped conductive material, each insulating wall having a first conductive surface in electrical contact with the U-shaped conductive material and a second conductive surface electrically connected to the reference potential, the U-shaped conductive material and two first conductive surfaces defining a conductive cup, and

wherein each unit cell includes a means for electrically connecting the conductive cup to the electronic interface.

60. The array of Claim 59, wherein the conductive housing comprises aluminum.

61. The array of Claim 59, wherein the reference potential is ground potential.

62. The array of Claim 59, wherein the conductive material comprises copper.

63. The array of Claim 59, wherein the conductive material-clad insulating wall comprises a copper/fiberglass/copper laminate sheet.

64. The array of Claim 59, wherein the means for electrically connecting the conductive cup to the electronic interface is selected from the group consisting of a metal wire and a metal foil.

65. The array of Claim 59 comprising 64 Faraday cups.

66. The array of Claim 59 comprising 256 Faraday cups.

67. A Faraday cup detector array, comprising:

(a) a plurality of Faraday cups; and

(b) a partially insulated conductive housing in which the plurality of cups is supported, the conductive housing being electrically connected to a reference potential,

wherein the cup comprises a conductive material isolated from the housing through an insulator,

wherein the conductive housing comprises an oxidizable metal block having a length, width, and thickness, and a plurality of channels machined through its thickness for receiving the cups,

wherein the block is bonded to an insulating substrate having means for electrically connecting the cup to an electronic interface, the means for electrically connecting the cup to the interface being in electrical connection with the cup.

68. The array of Claim 67, wherein the oxidizable metal is selected from the group consisting of aluminum, copper, nickel, and titanium.

69. The array of Claim 67, wherein the conductive material comprises copper.

70. The array of Claim 67, wherein the reference potential is ground potential.

71. The array of Claim 67, wherein the insulator comprises aluminum oxide.

72. The array of Claim 67, wherein the insulating substrate comprises a printed circuit board.

73. The array of Claim 67, wherein the means for electrically connecting the cup to the electronic interface is a trace on a printed circuit board.

74. The array of Claim 67, comprising 64 Faraday cups.

75. The array of Claim 67, comprising 256 Faraday cups.

76. The array of Claim 67, wherein the array is a two-dimensional array.

77. A Faraday cup detector array, comprising:

(a) a plurality of Faraday cups;

(b) a partially insulated conductive housing in which the plurality of cups is supported, the conductive housing being electrically connected to a reference potential,

wherein the cup comprises a conductive material isolated from the housing through an insulator,

wherein the conductive housing comprises a silicon wafer having a length, width, and thickness, and a plurality of wells formed into its thickness for receiving the cups; and

(c) means for electrically connecting the cup to an electronic interface, the means for electrically connecting the cup to the interface being in electrical connection with the cup.

78. The array of Claim 77, wherein the conductive material is selected from the group consisting of polysilicon and tungsten.

79. The array of Claim 77, wherein the reference potential is ground potential.

80. The array of Claim 77, wherein the insulator comprises silicon dioxide.

81. The array of Claim 77, wherein the means for electrically connecting the cup to the electronic interface is a wire.

82. The array of Claim 77, comprising 64 Faraday cups.

83. The array of Claim 77, comprising 256 Faraday cups.

84. The array of Claim 77, wherein the array is a linear array.

85. The array of Claim 77, wherein the array is a two-dimensional array.

86. The array of Claim 77, wherein the wells are formed by a deep reactive ion etching process.

87. The array of Claim 77, wherein the wells are formed by an anisotropic hydroxide etching process.

88. The array of Claim 77 having a pitch from about 100 μm to about 500 μm.